

Effect of Engine Installation on Jet Noise using a Hybrid LES/RANS Approach, Phase I

Completed Technology Project (2010 - 2010)



Project Introduction

Installation effects arising from propulsion airframe interaction are known to produce substantial variations in the in-situ jet noise. A hybrid LES/RANS computational framework is proposed for prediction of noise from the engine and airframe, and interactions between airframe and propulsion systems. The basis of LES (large eddy simulation) is that the energy-bearing turbulent eddies in the dominant noise-generating region are directly captured in the simulation. Since LES must resolve the turbulent eddies it requires a grid which captures these motions; the number of grid points needed for LES is much larger than those for RANS and thus a brute-force LES of the entire noise producing region in a propulsion-airframe interaction problem is not feasible. However, the noise generation physics of these flows allows a logical assembly of a hybrid simulation tool where low-fidelity models (RANS) in one region of the flow are combined with turbulence-resolving models (LES) in other regions of the flow. Acoustic effects are another segment of propulsion-airframe interaction problem. Sound generated by various components of engine is altered by the presence of wing, fuselage, deployed flap etc. In the present proposal, alteration of sound due to the presence of airframe is added through application of Boundary Element Method (BEM) and an acoustic projection technique (FW-H surface method). To demonstrate the feasibility of using this framework, we focus on simulating flow configuration corresponding to a separate-flow nozzle of by pass ratio 5 with round fan and nozzle operating at the takeoff cycle point of with freestream Mach number of 0.28. Simulation results will be validated against experiments carried out in the Low Speed Aeroacoustics Wind Tunnel (LSAWT) at NASA Langley's Jet Noise Laboratory (JNL). The high-fidelity model developed and validated in Phase I will be extended to explore more complex engine/airframe configurations in Phase II.



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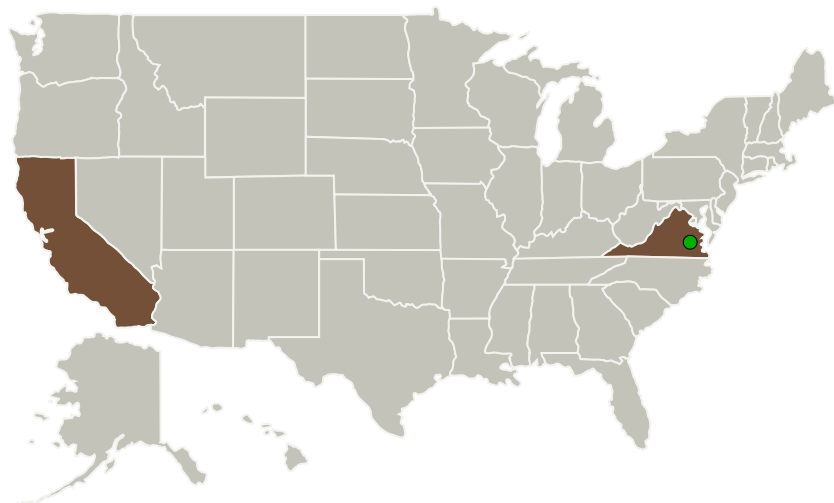
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CASCADE Technologies, Inc.	Lead Organization	Industry	Palo Alto, California
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

California	Virginia
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Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138959>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CASCADE Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

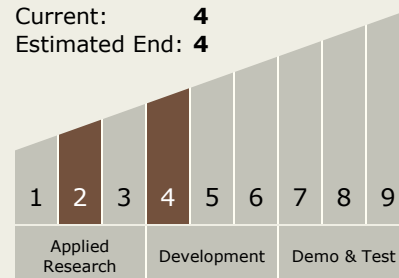
Carlos Torrez

Principal Investigator:

Yaser Khalighi

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.4 Aeroacoustics

Target Destinations

The Sun, Earth, The Moon,
Mars, Others Inside the Solar
System, Outside the Solar
System